

Amendment and Response

Page 13 of 19

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES

Remarks

The Office Action of June 11, 2003 has been received and reviewed. With claims 58, 59, 66, 74, 81, 83, 93, 102, and 106 having been amended, claims 107-109 claims having been added, and no claims having been canceled, the pending claims are claims 58-109. Reconsideration and withdrawal of the rejections, and entry and consideration of the new claims, are respectfully requested in view of the remarks presented below.

The 35 U.S.C. § 102 Rejection

Claims 58, 61-66, 69-73, 83, 88-93, 96-100, 101, 102, and 105 were rejected under 35 U.S.C. § 102(e) as being anticipated by Summerfelt (U.S. Patent No. 6,117,689). Applicant traverses this rejection for at least the following reasons.

Of the rejected claims, claims 58, 66, 83, 93, and 102, are independent. While Applicant disagrees with the assertion that these claims are anticipated by Summerfelt (e.g., Summerfelt does *not* teach the "pooling" aspects described by Applicant), these independent claims have been amended to include recitations which are clearly lacking in Summerfelt. For example, claim 58 (from which claims 61-65 depend) has been amended to recite annealing the substrate assembly including the patterned metal-containing adhesion layer and the platinum thereon, causing islands of non-adhered platinum to form on the at least one exposed surface region of the substrate assembly, while portions of the platinum on the patterned metal-containing adhesion layer adhere in a configuration substantially the same as that of the adhesion layer. Amended claims 66, 83, 93, and 102 recite similar language.

Support for these amendments may be found at numerous locations throughout the specification as originally filed, see, e.g., page 3, lines 23-25; page 5, lines 25-29; page 14, lines 15-18; page 15, lines 5-10; page 17, lines 5-7; and the figures.

Summerfelt is directed to a method of forming an oxygen-diffusion resistant electrode for high-dielectric-constant materials. More particularly, Summerfelt describes an integrated circuit having an array of microelectronic structures, with each of the microelectronic structures having an oxidizable layer, a barrier layer overlying the oxidizable layer, a single crystal oxygen stable

Amendment and Response

Page 14 of 19

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES

layer overlying the barrier layer, and a high-dielectric- constant material layer overlying the oxygen stable layer, (see e.g., col. 2, lines 42-47).

To achieve its objective, Summerfelt describes recessed TiN plugs on a substrate that provide preferential nucleation of platinum, thereby separating nucleation "on" the plug from that "off" the plug. After some platinum nuclei have nucleated on the substrate, the substrate may be annealed to promote Ostwald ripening. During annealing, small platinum nuclei become smaller and eventually disappear, while larger, more stable nuclei grow at the expense of the smaller nuclei. During this process, two small, closely spaced nuclei will rearrange such that only one platinum nucleus remains, (see e.g., col. 7-8. The platinum will "nucleate preferentially in the plugs 74 and then establish a depletion zone around the plugs 74," (col. 7, lines 57-62).

Summerfelt does not, however, teach that, during annealing, islands of non-adhered platinum may form on the SiO₂ layer 34, while portions of the platinum on the TiN plugs 64 adhere in a configuration substantially the same as that of the plugs. Rather, Summerfelt teaches only the formation of nucleation sites that merely undergo Ostwald ripening, both on the plug 64 and on the SiO₂ layer, during annealing. That is, there is not teaching in Summerfelt of platinum on a patterned metal-containing adhesion layer adhering in a configuration substantially the same as that of the adhesion layer as claimed.

Moreover, there is no teaching that the platinum on the SiO₂ layer of Summerfelt is unadhered. To the contrary, the unwanted nuclei 72 of Summerfelt are described as removed via etching (see, e.g., "Pt nuclei 72 are etched from the surface . . . 34 using . . . a reactive ion etch," *Summerfelt*, col. 10, lines 22-24).

For at least these reasons, Summerfelt fails to anticipate independent claims 58, 66, 83, 93, and 102. Claims 61-65, 69-73, 88-92, 96-101, and 105 are also submitted to be novel not only in view of their dependence, but also due to the particular subject matter recited therein. As a result, reconsideration and withdrawal of the rejection are requested.

Amendment and Response

Page 15 of 19

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES

The 35 U.S.C. §103 Rejection

To establish *prima facie* obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art document (or documents when combined) must teach or suggest all the claim limitations.

M.P.E.P. §2143.

Claims 59, 60, 67, 68, 74-80, 85-87, 94-95, and 103

Claims 59, 60, 67, 68, 74-80, 85-87, 94-95, and 103 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Summerfelt (U.S. Patent No. 6,117,689). Applicant traverses this rejection for at least the following reasons.

Claims 59 and 60 depend from claim 58; claims 67 and 68 depend from claim 66; claim 74 is independent with claims 75-80 dependent therefrom; claims 85-87 depend from claim 83; claims 94-95 depend from claim 93; and claim 103 depends from claim 102.

Amended claim 74, similar to the independent claims discussed above with respect to the 35 U.S.C. § 102(e) rejection, now recites: annealing the substrate assembly at a temperature of about 1100°C or less, causing the platinum layer to form unadhered pools on the surface of the substrate assembly, while portions of the platinum layer on the patterned metal-containing adhesion portion are maintained in a configuration substantially the same as that of the adhesion portion. Thus, all the claims of this rejection include generally similar annealing recitations.

Applicant submits that Summerfelt does not teach or, for that matter, even suggest an annealing step wherein the platinum nuclei 72 form unadhered pools on the SiO₂ layer 34, while portions of the platinum layer on the TiN plug 64 are maintained in a configuration substantially the same as that of the plug 64. In fact, the figures and description shown nuclei forming similar shapes on both the surface of the SiO₂ layer 34 and the plug 64 (see e.g.,

Amendment and Response

Page 16 of 19

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES

Summerfelt, Figures 11a and 11b). Moreover, there is no teaching identified that the nuclei on the SiO₂ layer 34 are non-adhered as the removal method described in *Summerfelt* is via reactive ion etching (see, e.g., col. 10, lines 22-24).

Applicant further traverses the assertions of the Office Action regarding the alleged obviousness of forming a platinum layer of a particular thickness (e.g., 500 Å or less) and annealing the substrate assembly at a particular temperature (e.g., 1100 degrees C or less). (See *Office Action*, page 5). For example, Applicant has identified unique characteristics of platinum layers of certain thicknesses (see, e.g., page 15, lines 3-10: "[i]t has been found that the platinum layer having a thickness of 700 Å or more does not form pools that are easily removed in accordance with the present invention").

For at least these reasons, Applicant submits that claims 59, 60, 67, 68, 74-80, 85-87, 94-95, and 103 are not obvious in view of *Summerfelt*. Reconsideration and withdrawal of the rejection are, therefore, requested.

Claims 81, 82, and 106

Claims 81, 82, and 106 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Summerfelt* (U.S. Patent No. 6,117,689) in view of Gandhi (VLSI Fabrication Principles). Applicant traverses for at least the following reasons. Applicant notes that claims 81 and 82 depend from claim 74 and thus include all the recitations of that base claim.

Claim 106, in a manner similar to the other independent claims discussed above, has been amended to recite: annealing the substrate assembly including the conductive metal layer, whereby the conductive metal layer forms pools of conductive metal material on the surface region of the substrate assembly, while portions of the conductive metal layer on the metal-containing adhesion region are maintained in a configuration substantially the same as that of the adhesion region.

Gandhi describes various rinsing techniques that may be used to remove ionic and atomic contaminants from a wafer surface. Such contaminants may be introduced during various stages of semiconductor processing, e.g., etching.

Amendment and Response

Page 17 of 19

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES

Applicant submits that Summerfelt, as already described herein above, fails to teach or even suggest forming the unadhered pools of platinum (as recited in claims 81 and 82), or pools of conductive metal material (claim 106), on the SiO₂ layer 34 while the platinum or conductive metal layer on the TiN plugs 64 are maintained in a configuration substantially the same as that of the plugs. Nothing is identified within the teachings of Ghandi that remedies this deficiency.

Moreover, Applicant submits that there is not suggestion to combine the single crystal growth technique of Summerfelt with the cleaning methods of Ghandi as alleged by the Office Action. For example, there is no teaching identified in Summerfelt that the platinum nuclei 72 could be removed from the SiO₂ layer 34 (see Figure 13b) by any type of rinsing over any specified period of time. To the contrary, Summerfelt indicates otherwise when it describes the use of a high density, low pressure reactive ion etch to remove the nuclei 72 from the substrate.

For at least these reasons, it is requested that the rejection of claims 81, 82, and 106 over Summerfelt in view of Ghandi be withdrawn.

Claims 84 and 104

Claims 84 and 104 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Summerfelt (U.S. Patent No. 6,117,689) in view of Nishioka et al. (U.S. Patent No. 5,489,548). Applicant traverses for at least the following reasons.

Claims 84 and 104 depend from claims 83 and 102, respectively, and thus include all the recitations of these respective base claims. Applicant again submits that Summerfelt fails to teach or suggest: annealing the substrate assembly, causing islands of non-adhered platinum to form on portions of the at least one surface of the substrate assembly, while portions of the platinum layer on the discontinuous metal-containing adhesion layer adhere to the adhesion layer in a configuration substantially the same as that of the adhesion layer (claim 84); or annealing the substrate assembly including the patterned titanium nitride adhesion layer and the material comprising platinum, causing islands of the material comprising platinum on the at least one exposed surface region of the substrate assembly, while portions of the material comprising platinum on the patterned titanium nitride adhesion layer are maintained in a configuration

Amendment and Response

Page 18 of 19

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES

substantially the same as that of the adhesion layer (claim 104). There is nothing identified in Nishioka et al. that remedies these deficiencies.

For at least these reasons, Applicant requests that the rejection of claims 84 and 104 be reconsidered and withdrawn.

New Claims

Applicant requests entry and consideration of new claims 107-109, which find support in the application as filed (see, e.g., page 3, lines 23-25, Figures 1a-1c).

Other Claim Amendments

Claim 59 has been amended to correct a typographical error. Claim 81 has been amended to better correspond to amended claim 74. These amendments are not intended to narrow the scope of these claims in any way.

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Page 19 of 19

Amendment and Response

Serial No.: 09/812,157

Confirmation No.: 2941

Filed: March 19, 2001

For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR
DEVICES**Summary**

It is respectfully submitted that the pending claims 58-109 are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicant's Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for
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CERTIFICATE UNDER 37 CFR §1.8:

The undersigned hereby certifies that this paper is being transmitted by facsimile in accordance with 37 CFR §1.6(d) to the Patent and Trademark Office, addressed to Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 11th day of September, 2003, at 4:56 PM (Central Time).

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